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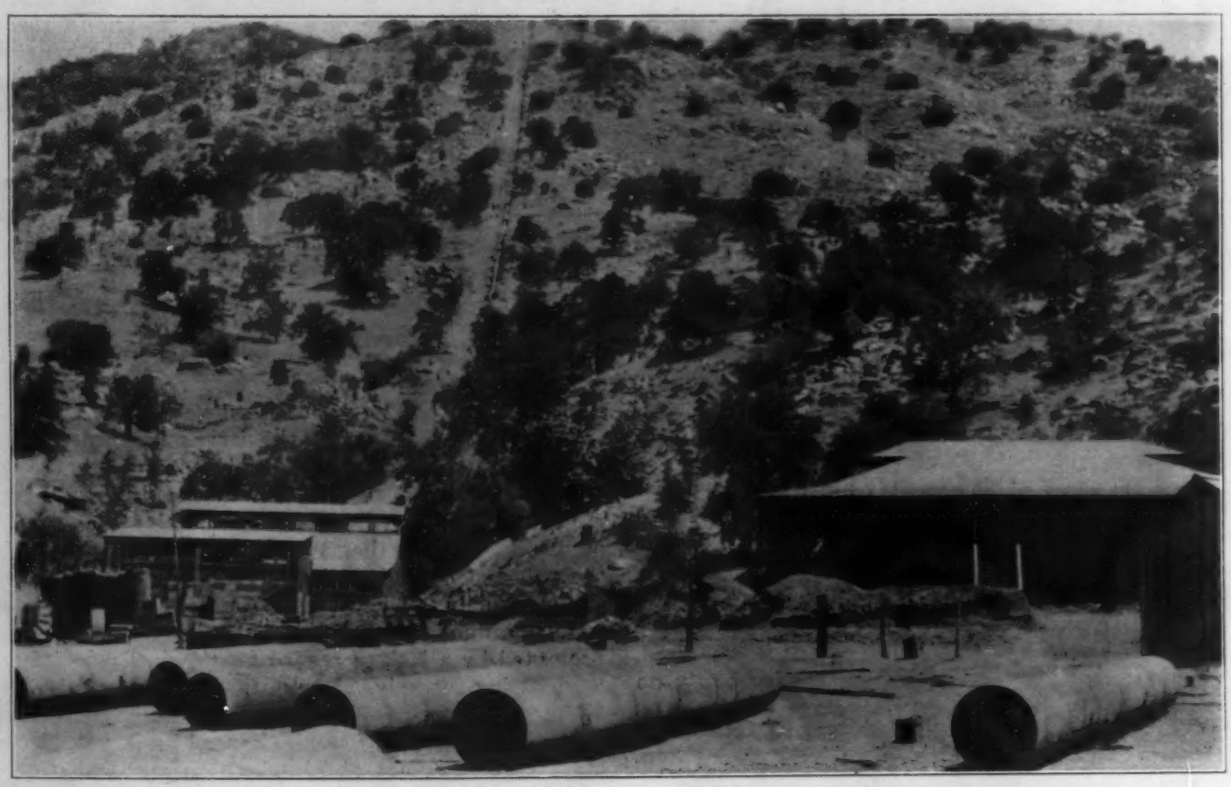
HYDRO-ELECTRIC POWER AS APPLIED TO IRRIGATION[1]

BY JOHN COFFEE HAYES.

Among the many uses to which hydro-electric power is being applied, that of electrically pumped water for irrigation is being advocated at present in a great many instances; and while the mere pumping of the water is so simple as to be hardly worthy of discussion, it may be of interest to point out some of the operating conditions encountered in a project formed chiefly for this purpose.



Mt. Whitney Power Co.'s Tule River Power Plant During Construction.

A hydro-electric system to supply power for pumping water for irrigation will usually be required to build up its own market in the territory served, and it is manifestly necessary at the outset to carefully study the territory. Usually some pioneer work by progressive farmers will show what the land is capable of producing, but the greater part of the territory will consist of barren country planted to grain, or used for grazing purposes, with here and there a town. This land is in large holdings, and the first thing to be determined is the amount of subdivision which may be expected, and whether the proper men are in the field to bring this subdivision about. The character of the land is, of course, of primary importance and the percentage of good land should be carefully determined. Irrigated land should have a slight slope for distributing the water and must be reasonably smooth. Hard pan near the surface must be guarded against, as it generally denotes a rather poor quality of soil. The adaptability of the soil for different products and

[1]Abstract of paper read at Pacific Coast meeting A. I. E. E., May 6, 1910.

the climate should be considered, yet data on these two points are hard to get and are usually unreliable. Tests and analysis of the soil would seem to be the natural way of determining its adaptability to the different products, but the agriculturist pays very little attention to these analyses, and has apparently a good reason for this, as they are often unreliable.

In the San Joaquin and Sacramento valleys it has been demonstrated that almost any kind of products may be raised on the good lands. Only a small portion of this land has been planted to citrus fruits, but small groves may be found along the entire length of the valley, and it would therefore seem as though it were all adapted to this class of products if water is applied. The best conditions seem to exist, however, where the mountains rise abruptly from the valley, and the level flat land extends up to the foothills, for, where a long stretch or rolling country lies between the plains and the hills, hard pan and bedrocks are generally very much in evidence.

Due to the fact that the oranges in the San Joaquin valley ripen and are marketed a full month earlier than those in the southern part of the State, they bring exceedingly good prices, and the growth of this industry is very rapid. The present citrus districts, as in fact is most of the land in the citrus belt, are above the existing irrigation canals, which in most instances divert all of the water available from the rivers, and are therefore entirely dependent on ground waters for irrigation; and, as the profits from this crop warrant a large expenditure, it is naturally the best market for power for pumping purposes. Aside from citrus fruits, all kinds of high-class products, such as deciduous fruits, berries, vegetables, nuts, vines and alfalfa are to some extent also irrigated by pumped ground water.

The amount of water required for the irrigation of different products varies to such an extent in the different communities that it is impossible to get any figures which would be at all accurate. The character of the soil is accountable for the difference to a large extent, but the cost of water and the personal equation are accountable to a very much larger extent. There is usually a marked tendency to the overuse of water. The duty of irrigation water in California is believed to average about 2 ft. in depth in addition to the average rainfall.

In the Imperial valley, in 1906, 120,000 acres were irrigated and a total average depth of 2.04 ft. was used, the main crop being grain. In San Diego county on land planted to citrus fruits an average depth of 1.5 ft. was used from 1889 to 1899. Around Los Angeles it is estimated that an average depth of 2.4 ft. is used.

In the Modesto and Turlock districts as much as 8 ft. to 10 ft. in depth was used at the start, but in 1908 the depth varied from 1.2 ft. to 3.6 ft. In the Fresno district very little water is applied to the surface of the land at present, the land being sub-irrigated by seepage from the canals.

The San Joaquin and Sacramento valleys are favorable storage basins for ground waters, as the only outlet is the San Francisco bay through the narrow straits of Corquinez. The elevation of the Lindsay district two hundred and fifty miles away is about 300 ft., and the ground waters must, therefore, of necessity travel very slowly and be in large quantities.

In determining the policies and the scope of a proposed hydro-electric system for the supply of power for pumped irrigation, it is necessary to determine at the outset the exact territory to be served and the general policies to be followed as regards charges, contracts, extensions, etc., or, in other words, a definite goal must be set, the power company must do everything possible to assist development, and any inhabitant in any section of the territory must be supplied with power whenever it is required. Therefore, the power system simply grows up with the country, and while this growth is taking place (it of necessity must take many years), it must be considered that the power system is in course of construction during the entire period. This is the main feature in which the power project depending entirely upon an irrigation market differs from the project supplying ordinary commercial business in an already well settled community, and this is a difference which is seldom fully understood and the time element not fully provided for.

The Hydro-Electric System.

The character of construction of a system depends entirely on the class of market, and for irrigation a slight discontinuance of service is not serious, therefore a light construction is permissible. The generating stations at the outset should be of a fairly permanent character, but the distributing system may and actually should be of a light and in many cases even bordering on a temporary character, as it is necessary to economize in every way at the outset to warrant the low rate which it is necessary to charge in order that the market may be developed; for it is necessary at the outset to establish a rate which will continue in effect when the system is fully developed. Even the expense of the generating stations may be reduced to a considerable extent at first, and as the system increases and the market becomes concentrated, improvements of a more permanent nature may be added.

Notwithstanding this, the writer has heard engineers of standing make the broad statement that there was no excuse for the use of a wooden flume and that a tunnel was the only proper thing; also that certain plants were altogether too flimsy and temporary in their design, and that the wooden pole line was entirely obsolete. When these statements are made, the writer cannot but think that the assertions are prompted by a lack of regard for the first principle of engineering, namely, economy. Every one who has had any experience with the wooden flume knows the many interruptions of service caused by it, yet, if constant service is not absolutely necessary, what possible type of construction can compare with the flume. It is short lived, but several can be built for the cost of a tunnel, and during the early life of a transmission system every dollar counts. If the system warrants a tunnel, it may be constructed during the life of the flume to take its place. Of course, if the system depends entirely upon one power plant, the replacement of the flume is both difficult and expensive, but few existing systems of any importance rely entirely on one plant, and there is usually sufficient capacity available during certain periods of the year to allow for the shutdown of one station. Also an auxiliary

steam plant is often cheaper than a tunnel and much more useful.

Wooden pole lines are also perfectly reliable in our California climate and are a very worthy substitute for the steel tower lines in respect to business development, and there is nothing to prevent the construction of the tower line when the wooden pole has outlived its usefulness; no interruption of service is necessary, as the right of way should be wide enough to accommodate both lines.

Among the different parts of the system where considerable expense may be saved is the switching gear, which may be extremely simple at the outset and

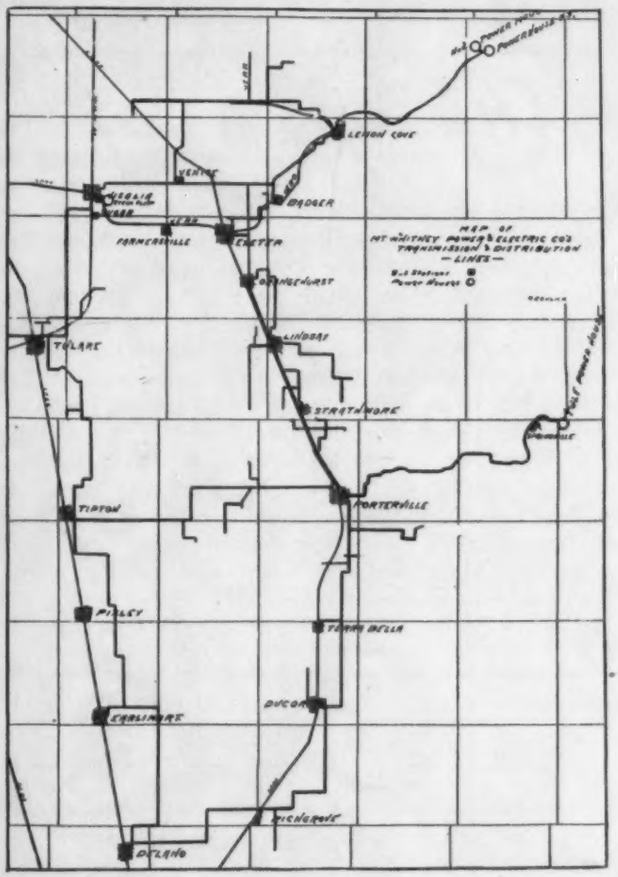


Fig. 1.

still ample. A small galvanized iron building on a wood frame is a thoroughly satisfactory building for the pioneer substation, which can be replaced by a permanent and fireproof structure when the business warrants. By the construction of light, inexpensive tie lines one substation may be arranged to temporarily supply the territory of another, and by the construction of a ring system many miles of expensive transmission line may be replaced by a much lighter class of construction, which will answer all purposes for many years.

In the greater part of California the conditions are ideal for long pole spacing. High winds seldom occur and sleet is unheard of, but it is not uncommon to see a line consisting of three wires ranging in size from No. 2 to No. 8 supported by poles spaced from 120 ft. to 150 ft. apart. However, on new lines, the fallacy of this mode of construction is apparently being realized, and much of the new work looks different. In one case the writer has seen a pole spacing of over 500 ft. in use on light lines, 40-ft. poles being used, which made a very nice appearing and businesslike line. Due to the less number of poles used, better poles, cross-arms and insulators may be indulged in. Other details may be treated in a similar manner.

Description of Typical System.

The writer has been connected for several years with probably the only hydro-electric power project that depends almost entirely on pumped irrigation for a market, approximately 70 per cent of the power generated being used for this purpose, the balance of the power being used for the ordinary commercial purposes in towns and settlements within the territory served, and for the operation of one interurban railway. The entire territory, however, is supported by the agricultural and horticultural products, and, therefore, the system is believed to be almost as nearly an exclusive power pumping system as can be imagined. The actual conditions obtaining on this system should apply closely to conditions which may be expected in other similar projects.

Territory—The territory of the company referred to comprises approximately 1,050 square miles in Tulare and Kern counties, California, being a strip of country about 50 miles long north and south, and 22 miles wide. The only available gravity waters for irrigation are the waters of the Kaweah and Tule rivers, all of which have been long ago appropriated. This gravity water irrigates about 90,000 acres of land and the balance of the territory, or approximately 560,000 acres, must depend entirely on the ground waters for irrigation before they can be made to produce other than grain or pasturage. The average annual rainfall for the territory is about 10 in., and the soil and climate are admirably adapted for the production of all kinds of high-class products. The territory may be for convenience divided into two sections, the citrus belt comprising approximately 200,000 acres of land, and what may be termed the valley portion. In estimating the power requirements it is considered that approximately half of the land in the citrus belt will be planted to products requiring approximately half as much water as the citrus fruits.

Load Characteristics and Power Required for Pumping.

The load curve, Fig. 3, together with the connected load, Fig. 2, will show better than any individual examples the amount of power which is required for a large territory with varying water levels ranging from a few feet to 90 ft., and with lifts above the surface at the wells varying from two or three feet to several hundred feet, there being approximately 18,000 acres of land under pumped irrigation at present.

It is estimated that one horsepower used in the ordinary way during the respective irrigation seasons will irrigate an average of five acres of citrus fruits and 10 acres of other products in the citrus belt, and 16 acres of deciduous fruits, alfalfa, etc., in the valley section.

The following table was compiled from observation at typical pumping plants on the system. In the table the letters at the head of the columns signify as follows:

A. No. of acres of oranges.
B. Average age of orange grove.
C. No. of acres of vines.
D. No. of acres of alfalfa.
E. Horsepower capacity of motor.
F. Horsepower tested.
G. Depth of water during pumping season.
H. Height water is raised above surface of ground at well.
I. Total head.
J. Acres per installed horsepower.
K. Estimated depth of water available over land if operated continuously during pumping period based on 50 per cent plant efficiency.

Plant	A	B	C	D	E	F	G	H	I	J	K
1	30	3	...	...	5	5	86	4	90	6	2.9
2	40	3	...	...	5	3.0	66	4	70	8	1.8
3	54	15	...	...	12	12.1	50	5	55	4.5	6.3
4	50	3	...	...	7.5	5.2	45	5	50	6.7	4.2
5	16	13	...	...	5	4.7	87	3	90	3.2	5.1
6	20	13	...	...	5	4.5	65	5	70	4.0	5.7
7	23	12	...	...	5	4.7	65	5	70	4.4	5.1
8	10	10	...	...	2	2.4	66	4	70	5.0	4.5
9	48	11	...	...	10	9.1	70	5	75	4.8	4.4
10	40	5	...	...	5	4.6	..	..	80	8.0	2.3
11	33	3	...	...	15	12.9	30	100	130	2.2	6.2
12	16	7.5	...	...	10	10	20	100	120	1.6	8.2
13	110	2	...	...	27.5	27.6	40	5	45	4.0	8.8
14	70	3	...	...	15	15	80	..	80	4.6	4.2
15	35	6	...	...	10	7.8	40	..	40	3.5	8.8
16	135	5	100	...	85	69	20	80	100	2.7	4.6
17	66	3	...	...	10	9.7	40	..	40	6.6	5.8
18	111	2	...	...	15	15.8	27	5	32	7.4	7.1
19	140	7	...	...	50	50	60	90	150	2.8	3.6
20	145	7	...	...	50	32.8	60	87	147	2.9	2.4
21	..	..	30	...	15	12.8	28	2	30	2.0	18.8
22	120	10	80	...	47.5	40.1	50	..	50	4.2	6.3
23	..	..	74	...	15	16.2	35	5	40	5	7.2
24	..	..	...	240	10	7.0	0	8	8	24	3.9
25	..	..	...	160	5	5.6	0	16	16	32	3.5
26	..	..	...	260	15	19.2	16	5	21	17.2	5.5

The above table might be extended and averaged to show the horsepower and water required for the supply of various products and for the requirements of orange groves of different ages, but there are so many variable elements entering into each case that any such figures, even if based on an average of every plant on the system, would be, in the writer's opinion, practically worthless. In the case of the high lift

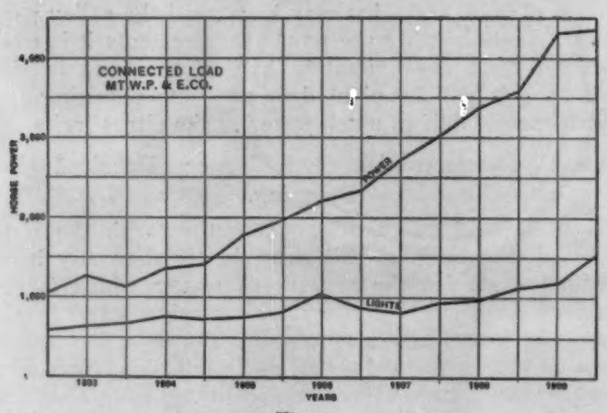


Fig. 2.

plants water is usually taken from the main pipe at different levels, but, as the current is charged for at the maximum demand rate and as the pumps are designed for the highest head, only the high head is taken into consideration.

Fig. 2 shows the increase of connected load on the system from 1903 to 1909, inclusive, for power and lights. This curve does not show the railroad load, which is 600 kw. and was connected in February, 1908, and operates at a load factor of approximately 30 per cent throughout the year. Of the total connected power load at the end of 1909, there was 3,776.75 h.p. used for the pumping of water, leaving 573.25 h.p. for commercial power purposes. This applies to all motors over ½ h.p., sizes under this being included in lighting.

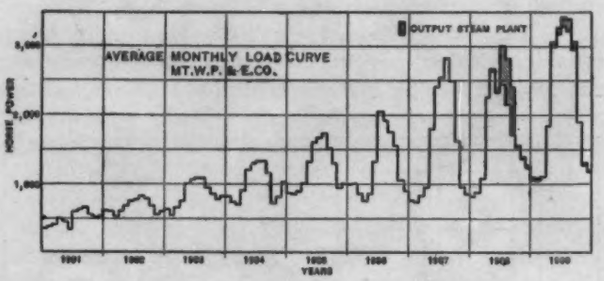


Fig. 3.

Fig. 3 shows the average monthly load curve at the generating stations for 1901 to 1909, inclusive. The shaded portion of this curve represents the load on the auxiliary steam plant, made necessary in 1908 by the disabling of one generator in No. 1 power house and an extremely low water period of the rivers; and in 1909 the steam plant floated on the line until the Tule river plant was completed late in the season, the other power stations being fully loaded.

Fig. 4 shows the load curve for the maximum demand during the years 1907, 1908 and 1909. It will be noted that the maximum demand at the power stations is very much less than the connected load, regardless of transmission losses, although the pumping load is considered extremely steady during the irrigation period, the pumping plants operating 24

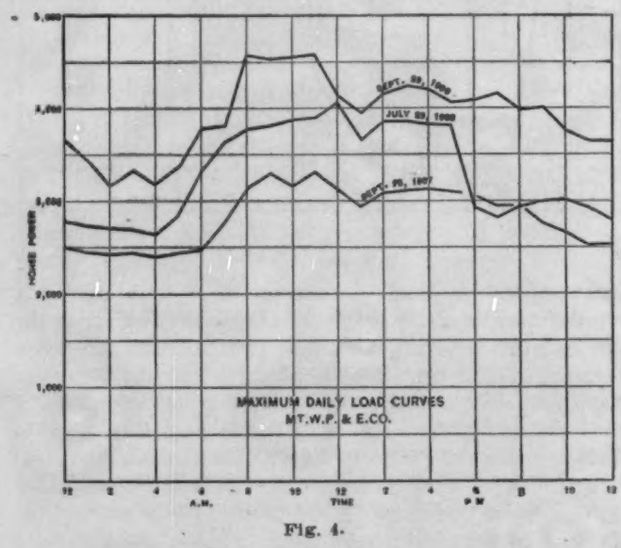


Fig. 4.

hours per day at as near the full capacity of the motor as possible. The lighting load has no appreciable effect on the generating stations during the time of maximum demand, as it is balanced by a certain amount of power used only during the daylight hours.

Fig. 5 shows the load factor of the system, and this also clearly points out an important condition

to be considered in an enterprise of this character, as it is comparatively low. This curve shows that a large amount of power is available for market during the winter and spring months, and with such market ob-

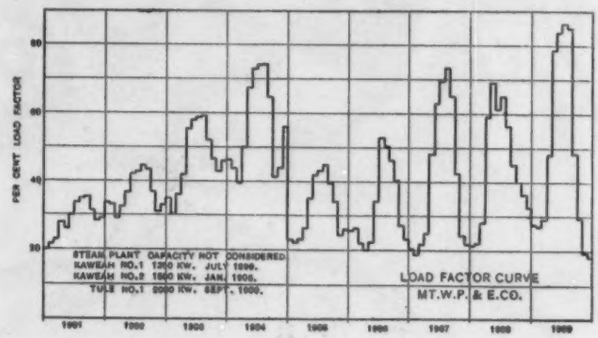

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Fig. 5.

tainable, the capacity of the generating stations could be greatly increased, as the flow of the rivers is greatest at this time.

Fig. 6 shows the characteristic flow of the streams during a very dry season, and is a combined curve of the Tule and Kaweah rivers. All of the rivers flowing into the San Joaquin valley have the same general characteristics, and a comparison of the load curve and this curve of stream flow shows the time of heavy load during the period of low water, and the generating plant must, therefore, be designed for the minimum flow of the stream unless suitable storage reservoirs are available. These reservoir sites are available

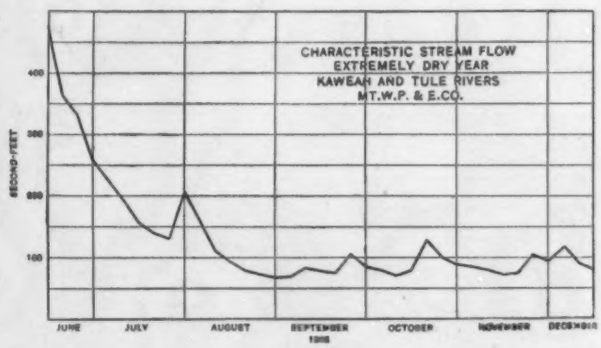


Fig. 6.

on some of the streams feeding the valley, but are scarce and expensive to develop, and the plants are designed for the minimum flow.

In connection with the load factor curve, it is to be noted that when the load factor reaches approximately 50 per cent it is necessary to construct an additional plant.

Generating Stations.

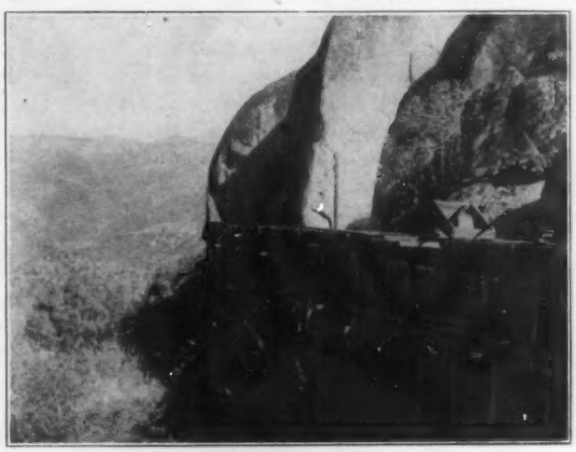
The generating stations consist at the present time of three hydro-electric power plants having an aggregate capacity of 4,850 kw. and one turbo-generator steam auxiliary plant having a capacity of 1,000 kw. Two of the water-power plants are on the Kaweah river and one on the Tule river, the steam auxiliary being in Visalia, the principal town on the system. The fourth water-power plant, which will have a capacity of 3,000 kw., will also be on the Kaweah river.

Power house No. 1 was the first constructed, and diverts the waters of the east fork of the Kaweah river through six miles of redwood flume. The plant was constructed in 1899, and the flume is today perfectly sound and will last at least 10 years longer before it will require replacement. The static head obtained is 1,310 ft. and the generators are driven by overhung wheels on the generator shaft. The equipment consists of three units of 450 kw. each, two

No. 1 Power House and Grounds.

belt-driven exciters and four 500-kw. transformers, one being a spare transformer. The transformers are oil-insulated and were designed to be self-cooled, but additional cooling is obtained by pumping the oil through coils on which water is sprayed. The transformers are located in individual compartments entirely separate from the power house, as are also the lightning arresters and high-tension switches.

Regulation is manual, controlling stands being situated in front of the switchboard, two of which operate deflectors which regulate the amount of water



Section of No. 1 Flume.

applied to the wheels by deflecting the stream, and one of which regulates the water supply to the third machine by a needle nozzle. At the penstock a regulating reservoir in the form of a large flume has been constructed, having a capacity of 25,000 cu. ft. The main function of this reservoir is to smooth out the daily variation of stream flow, as, due to the method of regulation at the power house, no great economy of water can be practiced, although the needle nozzle

allows the regulation of water to some extent. Since the other plants have been constructed, however, no regulation is done at No. 1, which simply takes a certain load and holds it.

Plant No. 2 was constructed during 1904 and put into operation in January, 1905. The water for this plant is diverted from the main Kaweah river and is conducted to the penstock through 15 flumes aggregating 0.87 mile, and 3.1 miles of ditch. The flumes are all redwood and the ditch is concrete lined, the ditch construction being used where the slopes will permit, the flumes being constructed on the rough broken ground and to cross ravines. A concrete lined penstock reservoir is excavated in the side of the hill having a capacity of 75,000 cu. ft. The static head is 360 ft. and the power house equipment consists of three units of 500 kw. capacity, each direct connected to high-head turbines regulated by Lombard governors. Two turbine-driven exciters are installed, which are hand regulated. Seven 350-kw. step-up transformers are installed in compartments outside of the power house, one being in reserve. The transformers are cooled in the same manner as those at No. 1 by circulating the oil.

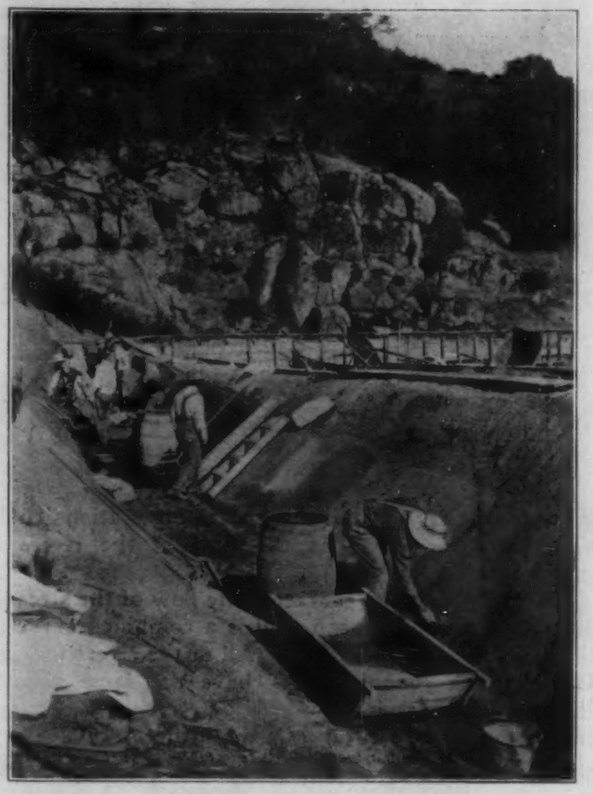
The No. 3 Kaweah plant, on which construction is just started, will divert water from the main Kaweah river, which after passing through a conduit 10 miles long, will discharge just above the intake of No. 2, thereby using the water twice. The static head of this plant will be 1,960 ft.

The transformers at Nos. 1 and 2 are arranged on trucks so that they may be easily run into the power house under the crane for repairs, etc., if necessary. In No. 1 individual tracks are run from each transformer, and in No. 2 a transfer truck is run on the track in front of the transformer compartments, so a transformer may be pushed out on to the transfer truck and taken to a short piece of track entering the power house. The switching gear in both stations is arranged so that the spare transformer may be immediately cut in in place of any other transformer.

The buildings at both Nos. 1 and 2 are constructed of corrugated iron on wood frame; foundations, floors and transformer compartments being constructed of concrete. The corrugated iron structure is, for all practical purposes, ample, as the climatic conditions are most favorable, and a protection from rain is about the only requirement necessary. These buildings are, however, cold in winter and hot in summer, and would not be considered strictly permanent or fireproof.

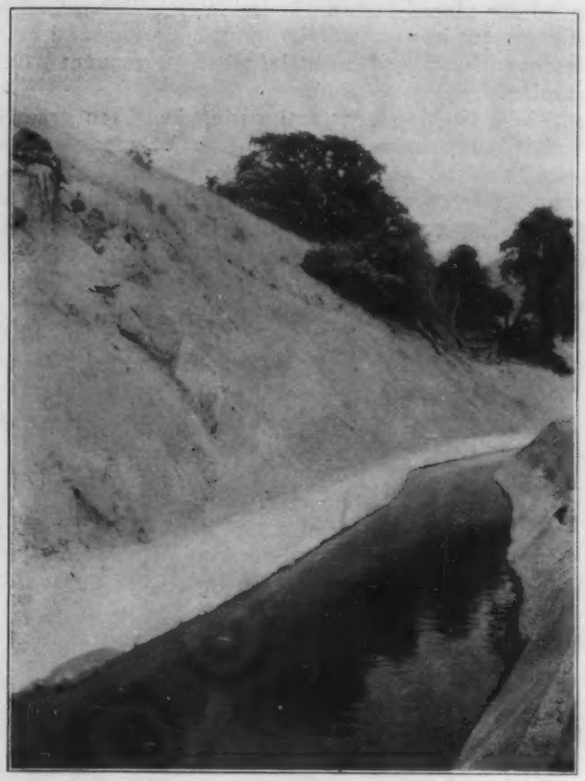
The third, or Tule river plant, was constructed in 1908 and 1909, and started operation in September, 1909. The water is diverted just above the junction of two forks of the river, there being two diverting dams and headworks from which short flumes lead to a point at approximately the junction of the river and join. The water is conducted to the penstock through 4.5 miles of pine flume, 2.06 miles of concrete lined ditch and 880 ft. of inverted siphon pipe, the siphon working under a 5-ft. head and having its lowest point 120 ft. below the conduit grade. This siphon was used to cross a long gulch.

The ditch is lined with concrete and excavated well into the mountain, very little reliance being placed on the filled bank, the water level being only 6 in. above the natural level of the downhill slope. The ditch is 4½ ft. wide and 3 ft. deep, the sides sloping 1 to 1. It is lined with concrete 2½ in. thick, over



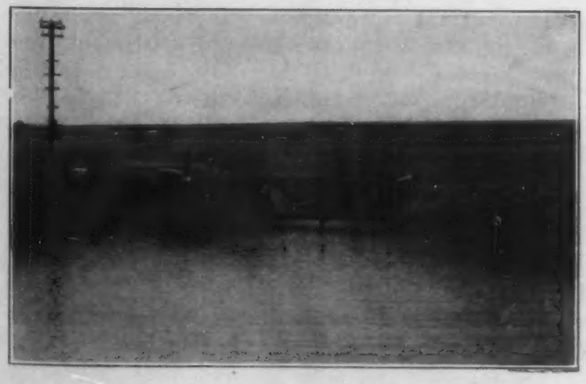
Ditch and Flume at Tule Junction.

Section of Concrete Ditch for Tule Plant



Tule Ditch.

Pumping Plant at Young Grove, at Exeter.



Small Irrigating Reservoir near Lindsay Heights.

which ½ in. of cement plaster is applied. A small amount of alum was mixed with both the concrete and the plaster, which renders the lining practically water tight. Due to the steep slope of the mountain side and the size and depth of the ditch, the sloping of the upper bank to a slope of 1 to 1 required considerable excavation. However, the finished product is a most permanent piece of construction. The flume is of the standard bent and stringer construction, the bents being placed 16 ft. apart, and a strip of burlap saturated with an asphaltum compound is placed under the battens for waterproofing.

At the penstock a regulating reservoir is excavated in the side of the mountain. A small portion of the upper end is 5 ft. deeper than the balance of the reservoir and is used as a sand-trap. The reservoir is 12 ft. deep, 350 ft. long and of an irregular shape, varying from 12 to 125 ft. in width, following the contour of the hill. The side slope is ½ to 1, and it is lined with 8 in. of concrete and ½ in. of plaster. A concrete wall at the end separates it from the penstock.

The reservoir has a capacity of 175,000 cu. ft., which will operate the plant 1¾ hours at normal load. Therefore, in the case of a break in the flume, sufficient time will be available to start the steam auxiliary plant without interruption of service. The reservoir also has sufficient capacity to regulate the daily fluctuation of stream flow during the low water period, so that the highest use may be made of the water. The static head is 1,135 ft., and the whole plant is designed with a view of ultimately doubling the present capacity.

The power house equipment consists of two 1,000-kw. units with overhung wheels, Lombard governors, directly actuating needle nozzles, an auxiliary nozzle being provided which automatically opens in the event of the main needle nozzle closing too quickly and ramming the pressure pipe. These auxiliary nozzles, when opened, close at a predetermined speed regulated by the dashpot principle. This arrangement allows the most economical use of the water. Two exciters, each of sufficient capacity for both generators are installed, one being driven by a water wheel and one by an induction motor. Seven 400-kw. water-cooled transformers are placed in the transformer room on one side of the power house, one transformer being held in reserve. Lightning arresters and high-tension switches are in a separate building.

The power house building and arrangement differ from the other plants in several respects. The power house is constructed of ferroinclave on a steel frame, the ferroinclave being plastered on each side with 1½ in. of cement plaster, therefore making a reinforced concrete roof and sides 3 in. thick. A partition of the same thickness divides the generating room from the transformer room and a similar partition divides the transformer room into two compartments, fireproof doors completing the separation. The switch house is constructed of the same material, and both buildings have metal window casings and wired glass windows, no wood being used in the construction. The above may seem inconsistent after the statement that the other power house structures were practically sufficient, and this would be the case were it not for the fact that the transformers which present a certain fire

Lindsay Sub-Station.

Pumping Plant and Grove.

Reservoir and Pumping Plant. Lift, 460 ft. Above Exeter.

hazard are placed in the power house building. Also the company has passed the pioneer period, and can, consequently, afford a little more permanent construction.

The switching gear and wiring has been greatly simplified by connecting the transformers in two banks, the spare one not being connected. The transformer "railway system" is also dispensed with, simple rollers being provided instead. In the event of an accident to one transformer its bank may be disconnected, the leads removed from the affected transformer, water pipes disconnected and the transformer skidded to one side. The spare transformer can then be skidded into place and connected up and the entire job performed in about one hour, certainly a short enough time for a system of this character.

In connection with all of the power stations, the question of the operator's comfort has been given proper attention. From a practical business point of view, this is a paying investment, as a much better class of men can be procured. Comfortable cottages are provided, the surrounding grounds are cultivated and a small ice plant is a part of the standard equipment. A few fruit trees and a garden will not only greatly improve the looks of the property, but will also greatly reduce the boarding house expense.

Transmission System.

As shown in Fig. 1, the transmission system is in the form of a figure 8 or a double ring. In this way current is available at both sides of any substation, thereby giving all of the advantages of duplicate lines. The main transmission line from power houses Nos. 1 and 2 feed in at the northeast corner of the system and the line from the Tule river plant feeds in at the center of the system. The steam auxiliary is in the northern ring and can consequently feed both ways. The old transmission lines have wires spaced 36 in., the sawed redwood poles being spaced 120 ft. apart. The new transmission lines in the valley consist of a double circuit, the 34,000-volt lines being placed on one side of the pole and a 6,600-volt distributing line on the other side. The circuits form equilateral triangles, the apex of which point downward; the wires are spaced 36 in. apart on each circuit. The main line from the Tule river plant consists of one circuit, the poles being of cedar 35 and 40 ft. in height and spaced 300 ft. apart. On all new lines a pole spacing of from 300 to 420 ft. is used, with 35- and 40-ft. poles, depending on the character of the country.

The current is distributed from 12 substations situated in the various towns and settlements, and the transmission and distribution systems are laid out to provide for additional substations as the load increases. The substation construction varies, all but one having started in the same way, namely, as a cheap wood or galvanized iron building with the most simple switching apparatus, and, as the substation grows in importance, substantial brick buildings are constructed with more or less elaborate switching gear, storerooms and offices.

The power is distributed at 6,600 volts and 2,200 volts, two-phase, the first distributing being at 2,200 volts; 6,600 volts eventually proved more satisfactory

on the power circuits. The city lighting systems distribute at 2,200 volts, two-phase, with the exception of two new systems, where three-phase has been adopted. There are 246 miles of 6,600-volt line, 53 miles of 2,200-volt line and 28 miles of lighting circuits of 2,200 volts and about the same length of low-voltage line with a connected load of 1,190 kw. of lighting transformers. The consumer supplies the secondary transformers for power supply and the power is measured on the primary side of these transformers.

Investment Value of a Power Irrigation Project.

The application of a hydro-electric system exclusively for the furnishing of power for pumped irrigation from an investment point of view is not of the get-rich-quick variety. The investor who wishes to receive immediate results on his money should not enter into any such scheme, unless the power company owns the lands to be put under irrigation, when the project develops into a real estate transaction, the power part being insignificant. Where the project is confined wholly to a power proposition, it should be gone into only by the most conservative investors or developers and pioneers who are content to bide their time and be satisfied for many years without dividends, but with the increased value of their investment. The power company must indirectly meet the opposition of other irrigation districts, and the large government projects, as well as the opposition of gasoline engines and other power, and the charges for service must be as low as possible.

The final results must be arranged for years before they are obtained and everything shaped to this end. A desire to hasten the marketing of the power may set some precedent which would be most difficult to overcome, and the failure to provide for emergencies may undo the work of years and completely demoralize a system. An overloaded system is to be particularly guarded against, as too much valuable produce depends entirely on the service, and any damage to the producer may completely stop development and stifle the entire community. The power company, therefore, has a very large moral responsibility to face, which is not to be lightly considered.

A single-stroke gas engine for automobiles, motor boats and aeroplanes has been invented by George Enderby and Henry Johnson of Harrogate, England, who claim that the ideal and popular engine under this system would probably consist of three cylinders, which would have only 7 working parts, and taking the speed of crank shaft to be 1,000 revolutions per minute, there would be 6,000 working strokes during the same period. Comparing it with a 4-cylinder of the present or Otto type, running at the same speed, the number of explosions or working strokes would be 2,000 during the same period, so that with the new engine even with one cylinder less the torque is three times as continuous; but taking the fact that the new engine is absolutely devoid of valves with springs, the speed of it is considerably greater and the turning movement is more like that of a turbine than an internal-combustion engine with piston and connecting rods. This new type of 3-cylinder engine would be equal to a 12-cylinder engine of existing type.

THE WATTHOUR METER.

BY WM. M. SHEPARD AND ALLEN G. JONES.

CHAPTER VII.

(Continued.)

Meter Troubles

Some of the most common troubles encountered in connection with watthour meters may be summarized as follows:

Excessive Vibration—If a meter is placed in such a position as to be subject to excessive vibration, creeping often results; vibration is also severe on the lower bearing. This trouble can in many cases be remedied by placing rubber washers between the meter and the wall upon which it is supported; in severe cases a spring suspended board is recommended. Wherever possible, meters should be installed in places that are entirely free from vibration or jarring effects. It is not unusual to find meters installed near doors which are often closed and opened, and especially is this bad practice where the wall or partition is of light construction.

Humming and Rattling of Induction Meters—This trouble is usually due to loose laminations in the magnetic circuit, and can be remedied by tightening them up. Rattling may also be due to a vibration of the disc and shaft in very loosely aligned meters, which trouble can usually be removed by carefully examining, locating and tightening the exact parts that may be loose. Excessive humming is sometimes caused by the potential winding being loose on the potential pole, which trouble can be easily remedied by driving small, flat wooden wedges between the insulating sleeve (upon which the coil is mounted) and the core.

Humming is not an inherent phenomenon of the induction meter, and trouble from this source can always be traced to some simple mechanical defect. It sometimes happens that the wall upon which the meter is mounted acts as a "sounding board," thus magnifying the humming of the meter. This can be corrected by the use of rubber washers as above mentioned for excessive vibration. It is best, however, to remove the meter to a place that will not be subject to such trouble.

Weakening of the Retarding Magnets—Magnets, after having been in service for some time, may become weak, due to the "aging" of the steel; this should not occur, however, if they have been thoroughly and properly treated before leaving the factory. Weakening due to aging is a very serious defect and shows the lack of proper methods or care in their manufacture. Such trouble should be guarded against in the selection of meters. The retarding magnets may also be weakened by the effects of powerful stray fields, or by heavy short circuits on the "load" side of the meter.

The retarding magnets should never be moved closer than one-quarter of an inch to the periphery of the disc, because if they are there will be a leakage of magnetic flux around the disc, from pole to pole of the magnets, thereby decreasing the number of lines of force that actually cut the disc. This of course will have the same effect as the weakening of

the magnets, and will cause the meter to run fast. Magnets that will not produce the necessary retarding effect when moved within a quarter of an inch of the edge of the disc are too weak and they should be discarded.

Sometimes it is found necessary to place iron shields around the damping system of meters which are not already provided with such a protection against stray fields, and when this is done the meter should be re-calibrated, since the proximity of the iron shield may allow a leakage of flux which would result in the same trouble as placing the magnets too near the periphery of the disc.

Bent Shafts and Buckled Discs—These troubles may be due to one of three causes; by abuse, by the effects of short circuits of a severe nature, or to faulty manufacture; the only remedy is to install new parts.

Creeping—Creeping may be due to "over-compensation" of the light load adjustment, vibration, high voltage, or a combination of any or all of these effects, or in commutating meters by the external resistance being short-circuited. Some types of induction meters have two small holes punched in their discs, the holes being diametrically opposite. When the part of the disc which has the hole in it comes under the influence of the electrical element, the torque is thereby sufficiently decreased to allow the disc to stand in that position when there is no current flowing in the series coils. This method very effectually prevents "creeping," but it does not affect the accuracy of the meter.

Creeping in the commutating type of meter can be very effectively eliminated by clamping over the edge of the disc a small piece of U-shaped soft iron wire; when the piece of wire comes under the influence of the retarding magnet the attraction of the magnet tends to hold the disc in that particular position, therefore preventing creeping on no load. The size of the clip can be so selected that it will prevent creeping, but which will not prevent the meter from starting on light loads nor affect the light load accuracy.

A modification of the last named method consists in attaching a piece of iron wire to the shaft of the meter in such a manner that its free end extends out radially and comes under the influence of the retarding magnets; the effect of the wire can be varied by bending it so that its free end comes closer to or further from the magnets.

Defective Jewels—The simplest and probably the easiest way of detecting roughness or defectiveness in the jewel bearing is to take the point of a sharp needle and gently "feel" the entire surface of the jewel. A fracture or any roughness can thus be detected. In this connection it might be stated that one of the best materials for cleaning the jewels and pivots is the pith from a cornstalk. After the jewel and pivot have been thoroughly cleaned, the pivot should be wiped with a clean rag which has been moistened with a high grade of watch oil, but under no conditions should it be flooded with oil.

Changing Position of Commutator on Shaft—If the commutator is shifted from its correct position on the shaft it will cause the meter to run slow; if it is shifted 90 degrees the meter will stop, and if shifted more than 90 degrees the meter will run backward.

Backward Rotation of Commutating Meters on Light Load—It may sometimes be found that the commutator meter will run in a reverse direction on light loads, while on heavier loads it will run in the proper direction. Such a trouble will be found due to a reversed connection of the compensating field, so that instead of helping the main field out, its action is differential. Care should therefore be taken to see that the compensating field is properly connected.

Open-Circuited Armatures—The current in entering the commutator divides at each brush and flows through the armature in two multiple paths of equal resistance; if one of these paths is opened, it will therefore be seen that the equivalent resistance of the armature will be doubled, which will cause the meter to run at about half speed. The same result may be accomplished by using an ordinary candle-power lamp and moving the connection from one bar to the other; the lamp will not light until after the defective coil has been passed.

The defective coil can very easily be located with a voltmeter. Apply the normal voltage to the two brushes and with one of the voltmeter leads permanently attached to one brush, move the other lead over the commutator from bar to bar, during which operation no deflection will be indicated on the voltmeter until the defective coil is reached, unless the movable voltmeter terminal happens to be passed over that half of the armature in which there are no open-circuits.

Friction in Upper Bearing—It sometimes happens that the upper bearing is pressed down too tightly against the upper end of the shaft, thereby causing excessive friction which will result in the meter running slow on light loads; this trouble is easily remedied by loosening the binding screw and raising the bearing slightly.

Friction in the Registering Mechanism—If the registering mechanism is allowed to accumulate dirt and grease it will develop undue friction; care should therefore be taken to see that the registers are kept in good, clean condition.

Dirt on Meter Disc—Small pieces of trash or dirt on the meter disc will, if they come in contact with the retarding magnets, or the stationary element, act as a brake on the meter.

(To be continued.)

The present high price of rubber is claimed to be largely artificial and due to the speculation which is rampant, particularly in London. The demand now exceeds the supply, but it is believed that as the new trees which are being so extensively planted and which require from five to seven years before producing, come into bearing, their product will glut the market. The 80,000 tons which the world is expected to produce in 1910 will hardly care for the needs of the makers of insulated cables and of rubber tires, and at the present rate of increase, prices will soon become commercially prohibitive.

DISCUSSION

RECONSTRUCTION.

The Editor—Sir: C. L. Cory's paper on the "Public Service Corporation" and the attendant discussion as published in the Journal of Electricity, Power and Gas brings up some interesting points on the subject of reconstruction which seem difficult to apply in the following case:

A locomotive in yard transportation service recently came up for a general overhauling. Of course we had been charging in to the overhead the cost for minor repairs, such as repairs to the cushions the engine driver sits on, new springs for the throttle lever, an occasional new brake shoe, and new grate bars now and then. It is my opinion that these charges should go into the overhead.

Now, in this general overhauling the engine received repairs such as new tires, rebore cylinders, new pistons, new piston rings, new journal brasses, new rod brasses, etc., with a general, thorough overhauling. The estimated cost for this work was: Direct labor, $360; direct material, $70; total direct charges (no indirect included), $430.

If we were far advanced in the science and practice of cost keeping we would probably have a depreciation account, and each year we would charge off from the capital value of the machine a certain amount which we would take up in a depreciation account, so that when the time came for a big overhauling of the machine we would pay for it from this depreciation account, charging the depreciation account with a proper proportion of overhead charges, and then we would set a new depreciation rate on the machine, taking it up in the capital account at its depreciated value before repairs plus this cost of repairs. However, we have no depreciation account. It, therefore, is my idea that the charges for this general overhauling should be sunk in the overhead, because I think the customer of the plant has to pay a percentage to cover this reconstruction work, as well as replacements, and as we have no direct allowance for depreciation we simply have to soak it into this overhead charge.

Please note that it is my opinion that the charge run into the overhead should be the $430 direct labor and material, with no figure for the overhead, because, although the expenditure of this amount, if applied to output, would bring a greater return than the sum of the labor and the direct material, still, considering the relation of the plant as a whole to outside interests, there is only a small amount of overhead and it really should make no difference how we charge it. On the other hand, as I have stated above, it is my opinion that if we had a depreciation account it should be credited and the capital account debited by the sum of the direct labor, direct material and overhead charges for the job.

All of the foregoing covers an example, I think, of reconstruction. In the case of minor repairs, which are not at all in the nature of renewals, I think the charges could go into the overhead. I think that the replacement of a worn-out and scrapped locomotive should come out of the depreciation account ordinarily, but where we have no depreciation account, should come out of the overhead.

The actual course followed was to charge the cost of these repairs plus the overhead to a specific order issued under an appropriation which is taken up really as output. ENGINEER.

[It would seem from this that the entire cost of the general overhauling of the locomotive, including all labor and material, estimated at $430, should under any conditions of operation or methods of accounting be charged absolutely to repairs and not to depreciation. Repair such a locomotive as much as you like; you simply keep it in operating condition, but there will certainly come a time when the entire locomotive must be replaced by a new one of more recent design, and unless your general overhauling and repairs increase materially the capacity of the locomotive all the expense of your overhauling is simply upkeep. Depreciation cannot be prevented by repairs, although they may postpone the inevitable march to the scrap pile.

Depreciation should never be charged against the capital account, but such depreciation should be met by a sinking fund, which may be drawn upon when needed to purchase or pay for absolutely new apparatus of the same capacity, and for the same use to replace obsolete and depreciated equipment, which must be abandoned as unfit for service because unsuited either in type, size or design by an advanced state of the art in manufacture or operation.

Depreciation should come annually from the cost of operation, but because a piece of apparatus has depreciated the money originally required to purchase it has not been reduced or diminished, but your sinking fund covering depreciation must, whenever called upon, be used to make your total equipment represent honestly the same capital investment originally put into your new equipment, which is not to be discarded.

The overhauling of such a locomotive is not reconstruction, but is really the repair of the machine. New tubes in the boilers should come from repairs and not from reconstruction. Of course if one chooses they may divide up repairs into different items, which might include such reconstruction.

Such repairs may very properly be charged to maintenance and operation, but in addition to all charges for maintenance and operation your accounts certainly should provide for a still further item which in general should include depreciation, obsolescence, extraordinary contingencies, and should be understood as to include everything which experience shows should be provided, and to keep the installation originally representing the total capital account in such a condition as it may honestly and fully represent such capital account at all times. Any reduction in the value of the plant must be made up from your depreciation account, and at any time the total capital account must be not less than the physical valuation at any time plus the sinking fund which is set aside to cover depreciation, obsolescence, etc.—Editor.]

DETERMINING COEFFICIENTS OF MODERN HIGH PRESSURE FRANCIS TURBINES.[1]

BY MARIO DORNIG.

With the steadily increasing utilization of water powers the opportunity has repeatedly arisen to build units of large capacity, i. e., for correspondingly large quantities of water even under high head. In such cases Pelton wheels with vertical shaft and several symmetrically arranged nozzles or such with several wheel runners on a common horizontal shaft do not form a solution that is either low in cost or convenient for the arrangement of the plant. Compared with such types of construction a high pressure Francis turbine has equally high efficiency, permits of equally good governing, requires considerably less space, and its arrangement is more compact and more easily accessible. On the other hand, the high turning speed resulting with this system means no difficulty to the builders of modern turbo-generators and permits at the same time a reduction in the weight of flywheel mass with the high peripheral speed, or rather to make better use of it by storing larger quantities of energy.

Several important plants with turbines of that type are enumerated in Table 1. There are further to be mentioned the plants of Hamilton-Niagara, Bussoleno, Landeck-Pians, Lend-Gastein, Reutte (near Fuessen), Kubelwerk-St. Gall, and several others. The latter, however, cannot be really called Francis-slow-runners. Also for the Walchensee competition some manufacturers have proposed turbine types for a head of about 650 feet.

TABLE I.

		H	Q	N	n	
1.	Jaice (Ganz & Co.)	245	46	1000	300	single
2.	Rauris-Kitzloch (Escher Wyss & Co.)	427	50	2000	450	double
3.	Centerville (Allis-Chalmers Co.)	585	198	9700	400	single
4.	Schaffhausen (Escher Wyss & Co.)	520	22	1000	1000	double
5.	Albulawerk-Zurich (Escher Wyss & Co.)	492	67	3000	600	double

H = Head in feet. Q = Quantity of water in second feet. N = Horsepower. n = Revolutions per minute.

We want now to bring together the determining basic factors for the calcuation of such slow-running turbines and consider their characteristic determining values separately.

As in the calcuation of high-speed-Francis-turbines, the discharge diameter is one of the most important dimensions; with slow-speed-turbines the entrance width (b) of the runner plays the most important part, since for mechanical reasons this must not drop below an absolutely fixed minimum (⅞ to 1⅛ in.).

If we take

$$1 + m = \frac{a + s}{a} = 1 + \frac{s}{a},$$

(a) meaning the width of discharge of the distributor and (s) the thickness of the vane, we get:

$$b = Q \frac{(1+m)}{c\, D\, \pi \sin \alpha}, \text{ and substituting } u = \frac{D \pi n}{60},$$

$$b = \frac{Q\,(1+m)\,n}{c\, u\, 60 \sin \alpha}.$$

[1]Translation by courtesy of Heinrich Homberger, Consulting Engineer, Pacific Building, San Francisco.

Since, however, $u\, c \cos \alpha = \epsilon g H$, we get

$$b \operatorname{tg} \alpha = \frac{1+m}{60 \epsilon g} \times \frac{Qn}{H} \text{ or}$$

$$b \operatorname{tg} \alpha = k_1 \frac{Qn}{H}, \qquad (1)$$

wherein $k_1 = \frac{1+m}{60 \epsilon g}$ is a constant.

Introducing the value N from the relation $62.4\, Q\, H\, \eta = 550\, N$, equation (1) becomes

$$b \operatorname{tg} \alpha = \frac{(1+m)}{60 \epsilon g} \times \frac{550}{\eta} \times \frac{1}{62.4} \times \frac{Nn}{H^2},$$ which, by combining the constant values as k_2 may be written:

$$b \operatorname{tg} \alpha = k_2 \frac{Nn}{H^2}. \qquad (2)$$

If we now take m between .1 and 0, or on an average $m = .05$ and $\epsilon = .84$ we get

$$b \operatorname{tg} \alpha = .000648 \frac{Qn}{H^2}, \qquad (1a)$$

where all dimensions are given in feet.

If we further assume $\eta = .75$ we get

$$b \operatorname{tg} \alpha = .007615 \frac{Nn}{H^2}. \qquad (2a)$$

With multiple turbines (b) has to be made equal the sum of the widths of the single runners; in case of a double runner with common distributor, however, (b) may become smaller than the sum of the widths of separate runners.

In case the head is very high it is necessary to increase the turning speed correspondingly; one can compromise on this, however, with large units to some extent by making α as small as possible—down to 15 degrees and less—but it must be taken into consideration that the value

$$a = \frac{\pi}{1+m} \times \frac{D}{Z_e} \times \sin \alpha \qquad (3)$$

must not become too small. Entirely wrong would it be in any event to try to reduce the value (b) by increasing the relative thickness of the vanes (m), because this would reduce the efficiency. It is rather advisable to shape the guide-vanes in such way that the value (m) may be taken practically to equal zero. Since (b) is independent of (D), consequently also of ρ, $k = \frac{u}{c}$ and β, these values have to be determined with respect to other circumstances.

To give an exact insight into this a diagram is given of the values of $\frac{w_1}{c}, \frac{u_1}{c}, \frac{c_1}{c}$, (wherein c equals $\sqrt{2 \epsilon g H}$) and of ρ as found for different values of β.

$w_1^2 + u_1^2 + c_1^2 - 2 u_1 c_1 \cos \alpha$, and, with reference to the relation $2 u_1 c_1 \cos \alpha = c^2$ we get

$$w_1^2 = u_1^2 + \frac{c^4}{4 u^2 \cos^2 \alpha} - c^2$$

$$\text{or } \left(\frac{w_1}{c}\right)^2 = \left(\frac{u_1}{c}\right)^2 + \frac{1}{\left(2 \frac{u_1}{c} \cos \alpha\right)^2} - 1 \qquad (4)$$

$\frac{w_1}{c}$ reaches its smallest value when $\left(\frac{u_1}{c}\right)^2 = \frac{1}{2 \cos \alpha}$

i. e., when

$$u_1^2 = \frac{c^2}{2\cos\alpha} \times \frac{2u_1 c_1 \cos\alpha}{2\cos\alpha} \text{ or when}$$

$$u_1 = c_1 \quad \beta = 90° - \frac{\alpha}{2}.$$

The curves of Fig. 1 show the interdependence of $\frac{w_1}{c}$ and $\frac{u_1}{c}$ with different values of α.

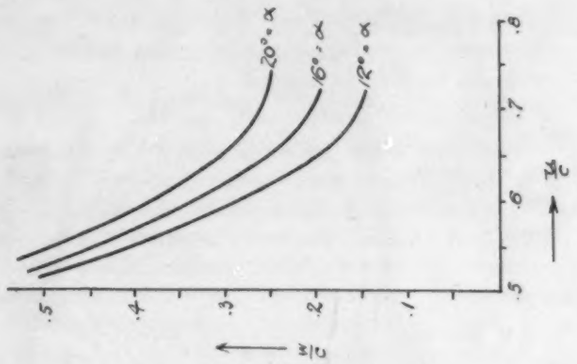


Fig. 1.

A simple calculation gives: for limit turbines

$$\beta = 180° - 2\alpha \quad \frac{w_1}{c} = \frac{1}{2\cos\alpha}$$

$$\text{for } \beta = 90° \quad \frac{w_1}{c} = \frac{\operatorname{tg}\alpha}{\sqrt{2}}$$

$$\text{for } \beta = 90° - \frac{\alpha}{2} \quad \frac{w_1}{c} = \sqrt{2}\,\frac{\sin\frac{\alpha}{2}}{\sqrt{\cos\alpha}},$$

or tabulated

α °	$\frac{w}{c}$ L	$\frac{w}{c}$ 90°	$\frac{w}{c}$ min.
20	.533	.257	.254
18	.527	.229	.227
16	.521	.202	.201
14	.516	.176	.175
12	.511	.150	.149

There is further:

$$\frac{u_1^{L}}{c} = \frac{1}{2\cos\alpha}; \quad \frac{u_1^{90°}}{c} = \frac{1}{\sqrt{2}}; \quad \frac{u_1^{90° - \frac{\alpha}{2}}}{c} = \frac{1}{\sqrt{2\cos\alpha}},$$

or, for $\frac{u_1}{c}$:

α °	$\beta = 180° - \frac{\alpha}{2}$	$\beta = 90°$	$\beta = 90° - \frac{\alpha}{2}$
20	.533	.707	.732
18	.527	.707	.726
16	.521	.707	.722
14	.516	.707	.719
12	.511	.707	.717

and for $\beta = 180° - 2\alpha$, $\frac{c_1}{c} = 1$,

$$\text{for } \beta = 90°, \quad \frac{c_1}{c} = \frac{1}{\cos\alpha\sqrt{2}},$$

$$\text{for } \beta = 90° - \frac{\alpha}{2} \quad \frac{c_1}{c} = \frac{1}{\sqrt{2\cos\alpha}};$$

herefrom the values of $\frac{c_1}{c}$ may be calculated by using the following table:

α °	$\beta = 90°$	$\beta = 90° - \alpha$
20	.754	.732
18	.744	.726
16	.737	.722
14	.730	.719
12	.724	.717

There is further:

$$\rho_{90} = 1 - \frac{1}{2\cos^2\alpha}; \quad \rho_{90} - \frac{\alpha}{2} = 1 - \frac{1}{2\cos\alpha},$$

$$\text{or } \rho_{90} > \rho_{90} - \tfrac{\alpha}{2} < .5.$$

This shows that if β is reduced or $\frac{u}{c}$ and D are increased, c and therewith the eddy and friction losses in the distributor, consequently the corrosion resulting from same becomes smaller; much larger, however, is the decrease of $\frac{w}{c}$ with increasing $\frac{u}{c}$; it is a well known fact, by the way, that sharply curved vanes give poor efficiencies with heavily changing load. On the other hand, the hydraulic friction of the runner body, the loss in the gap and the axial thrust, if such prevails at all, become larger with increasing β, i e. with increasing ρ and D.

The loss in the gap may be assumed to be proportional to the diameter of the runner and the square root of the pressure in the gap, since

$$H_2 = \epsilon H - \frac{c_1^2}{2g} = \epsilon H \left(1 - \frac{2\epsilon g H}{4u_1^2\cos^2\alpha}\right)$$

$$= \epsilon H \left(1 - 2\epsilon g H \times \frac{3600}{4\pi^2 n^2 D^2 \cos^2\alpha}\right)$$

and, if H and n are given

$$\text{Loss in gap} = \sqrt{AD^2 - B}$$

If the axial thrust is not entirely eliminated by using a double runner or a suitable balancing arrangement, this may be similarly made proportional to the reaction pressure and D^2, i. e.:

$$\text{Axial thrust} = A_1 D^2 - B_1$$

where the coefficients B and B_1 have to answer the same conditions

$$A D_L^2 - B = 0, \quad A_1 D_L^2 - B_1 = 0$$

for a limit-turbine of the diameter D_L. The strain of the runner by centrifugal force, however, is with

$$\beta = 90° - \frac{\alpha}{2}$$

almost twice as high as with a limit-turbine, and all dimensions and weights become larger with the larger diameter of the runner; the force required for shifting the guide vanes and the flywheel momentum of the revolving parts are also larger.

The last mentioned disadvantages originating from B=about 90°, although not inconsiderable, are not decisive when compared with the advantages gained, since with this type of high pressure turbines the losses due to shock and eddies caused by the water entering into the runner, the friction losses in the runner itself and the wear of the runner vanes play a much more important part.

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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Copper's cost, like its mines, has not reached bottom.

California produces an electric iron for the laundry and electric iron for the foundry.

Railway terminal electrification terminates traffic troubles.

Waterpower stock and bonds are booming.

The season for hunting alternators is never closed.

Aluminum is soaring, not in price but in airships.

Rubber is inflated in price as well as in tires.

Irrigation bonds inundate the market.

Celluloid insulation is greatly affected by the heat.

Waterpower Sites

"There are valuable water power sites through all the public land States." So said President Taft in his memorable "conservation" message, so say the muck-raking proclaimers of a waterpower trust, and so think most of the people who have been grievously misled by one of the greatest press bureaus that ever added its burden of franked mail to the postal deficit. It requires but one fact to negative the ninety and nine claims as to the tremendous value of waterpower sites—without development they are as worthless as so many sites for wind power.

Here in the West we know of no such entity as a waterpower site. The term is a misnomer which has insidiously crept into our language because of its kinship to that well recognized piece of property, a dam site. A dam may be used to produce a head of water from which power may be generated after the necessary ditches have been dug, pipe lines laid, buildings erected and machinery installed to make it a power plant.

But all this takes money and courage. Withdraw the capital and the site becomes as worthless as the day the water first started to run down the newly-raised hills. Capital is now so intimidated by the action of certain well-meaning, but ill-advised, enthusiasts, that it hesitates to assume the risk of such development when there are so many safe channels for investment. This hesitancy cannot but retard the growth of the country tributary and thus hurt our national prosperity. The hue and cry of a few zealots has assumed the dignity of a political issue and we are threatened with a policy of conservation that will prove more disastrous to the people's welfare than the most careless excess in utilizing Nature's bounties. A waterpower site is the direct antithesis to the proverbial poet in that it is made, not born. A location may have every advantage of topography and hydrography, and yet be so far from a market that an otherwise less desirable site is selected. This selection is more often governed by commercial considerations than by natural conditions. The mere combination of geologic relief and favorable meteorology gives a dam site no more value as a power plant site than does a pauper's unpatented invention constitute a commercial success. In other words, it is a mistake to consider a dam site a waterpower site. In rhetoric this process of naming a thing by one of its attributes is known as metonymy, but in business it is worse than foolishness to imagine that an undeveloped location is valuable as a waterpower site without the aid of capital.

CURRENT COMMENT

Examination for assistant engineer is announced by the United States Civil Service Commission on July 13-14, 1910, to fill vacancies as they may occur in the Reclamation Service in the positions of assistant engineer at salaries of $1500 per annum and upward, and junior engineer at salaries of $900 and upward.

A. I. E. E. officers elected at the meeting in New York City on May 17, 1910, were: President, Dugald C. Jackson; Vice-Presidents, P. H. Thomas, H. W. Buck, Morgan Brooks; Managers, H. W. Barnes Jr., C. E. Scribner, W. S. Rugg, R. G. Black; Treasurer, Geo. A. Hamilton; Secretary, Ralph W. Pope. The constitutional amendment relative to the manner of choosing the secretary did not carry.

Non-inflammable celluloid is again announced, this time in a paper by Prof. Gautier before the French Academy of Sciences. Celluloid is an excellent electrical insulation except for its dangerous liability to fire and should this new process, which substitutes an ether silicate for the alcohol and ether ordinarily used as a solvent for the camphor and nitrocellulose, prove successful, it has many commercial applications.

A wireless system in Brazil is provided in a contract signed between the Lloyd Brazileiro, the subsidized line of steamships serving Brazilian ports and New York, and the United Wireless Telegraph Company of New York for equipping 21 ships of the Lloyd line and eight stations along the Brazalian coast. One land station is to be at Rio Grande do Sul, one at Santos, three in and near Rio de Janeiro, one at Bahia, one at Pernambuco and one at Para. The system will afford communication between Rio de Janeiro and all the Lloyd fleet all the time, except the New York service when ships are out of range. Most of the passenger ships between Europe and South America and two ships running between New York and the eastern coast of South America are already equipped with wireless apparatus, and the proposed system will give a wireless service in the South Atlantic similar to that in the North Atlantic.

Deaths from electric shocks in Switzerland, which is bountifully supplied with electric power, have averaged less than 35 during the past five years. Of the 36 victims of last year, 28 were engaged in electrical callings and 5 were building mechanics, killed while working by coming in contact with live conductors, principally on the roofs of buildings. Of the remaining 3 victims, one was a servant, another a factory hand and the third a child. An analysis made of the accidents showed that the greater number was due to lack of precaution on the part of the victims, particularly in the case of the electrical employes. The servant attached a wire to a kite line to lengthen it and the wire came into contact with a 6,000-volt conductor. The child climbed the pole of a high-tension line and touched a conductor, death in this case being probably due to the fall.

The electric conductivity of soils has been found by O. E. Davis to increase almost directly as the moisture percentage, increases depending in part on the character of the soil, humus decreasing the conductivity and alkali increasing it.

A new tungsten lamp, the continuous wire type as distinguished from the ordinary series of separate filaments was described in a paper by C. F. Scott at the recent National Electric Light Association convention. A single 30-inch filament, elastically mounted as a spiral spring to each of the leading-in wires is loosely held by intermediate supports. This gives a filament not only of greater mechanical strength but also of more uniform resistance.

An electric ozonizer is a device that produces ozone by means of high tension electric discharges. Ozone is an unstable oxygen compound containing three instead of two atoms to the molecule, the third atom being particularly active in attacking germs, and consequently valuable in purifying polluted air and water. It has a peculiar penetrating odor familiar to all workers around electric apparatus but its commercial possibilities have been but recently applied. For use in sterilizing water, otherwise undrinkable because of organic or sewage content, it may ultimately become a desirable central station load.

Electrolytic separation of oil from condenser water is detailed in a paper read by Prof. H. M. Goodwin and Mr. Risdale Ellis at the recent Pittsburgh meeting of the American Electrochemical Society. The oil particles become negatively charged and migrate to the anode. With iron electrodes and a dilute sodium carbonate electrolyte basic ferrous carbonate is also precipitated at the anode carrying down the oil particles migrating there. But as the oil may be separated just as well by shaking the emulsion with precipitated basic ferrous carbonate the electrolytic method seems to offer no great advantage.

The right of condemnation for the electric transmission lines is sustained in a decision of the Court of Appeals rendered this week in California. The award of $50 per tower given W. A. Frederick, a property-owner of Pleasanton, Cal., by a lower court had been appealed upon the ground that the defendant company, the Tuolumne Water Power Company, had no right of condemnation and that the damages awarded were inadequate. The Appellate Court, in its decision, holds that an electric transmission line has the right of condemnation and that the sum of $50 per tower is a substantial consideration. The court, furthermore, holds that the choice of route lies with the plaintiff company and that, as long as the company is shown to be acting in good faith, the landowner cannot object if the company select any particular location for its line. This decision affects all of the interior counties of California where electrical transmission lines are being strung, and also San Mateo county, where much work of this nature has been undertaken.

PERSONALS.

Robert Catton of the Catton-Niell Co., Ltd., of Honolulu, is at San Francisco.

H. A. Kennedy, an electrical engineer of New York, is a recent San Francisco arrival.

Russell B. Cressman of Pass & Seymour of Solway, New York, is visiting the Pacific Coast.

E. N. Sanderson of Sanderson & Porter has returned to New York after a tour of the Northwest.

J. W. White, of the San Francisco office of the Fort Wayne Electric Works, has returned from a northern trip.

John W. McDowell of the Manhattan Electrical Supply Company of New York, was at Los Angeles last week.

Leon M. Hall, of Hall, Demarest & Co., has been making an electrical engineering investigation near Red Bluff.

F. A. Cressey Jr., manager of the Modesto Light & Water Company, has returned to Modesto after visiting San Francisco.

G. W. Bacon, of Ford, Bacon & Davis of New York City, has returned East after spending some time at the company's San Francisco office.

H. F. Gronan has succeeded Frank C. Kelsey, resigned, as engineer in charge of the Nisqually water power project of the city of Tacoma, Wash.

A. H. Lamm recently became associated with the Sacramento Valley Power Company's hydroelectric plant near Shingletown, Shasta County, California.

M. M. O'Shaughnessy is again at his San Francisco office, after spending several weeks in San Diego and vicinity in connection with water works extensions.

Harry E. Swett, formerly chief engineer of the Metropolis Bank Building, has accepted a similar position in the new Mechanics' Library Building on Post street.

D. M. Coughlin has taken charge of the new business department of the Spokane Falls Gas Company of Spokane, Wash., having resigned a like position with the Easton Gas & Electric Co. of Easton, Pa.

C. G. Pyle, Los Angeles representative of the Standard Underground Cable Company, will spend the first two weeks of June in a horseback trip through the mountains along the line of the Los Angeles aqueduct.

John Furness who was for many years chief engineer of the Palace Hotel, is now chief engineer of the Pacific Fruit Express Company's large pre-cooling and ice plant in connection with the Southern Pacific Company's yards at Roseville, Cal.

Martin Kubierschky, vice-president of the United Railways Investment Company, of New Jersey, recently arrived from New York. He has been looking over the properties of the United Railroads of San Francisco, in which his company has the holding interest.

Wynn Meredith, manager of Sanderson & Porter's Pacific Coast office, has gone to Victoria, B. C., and will remain in the Northwest for the next month or two. He will supervise the construction of the Jordan River development on Vancouver Island for the British Columbia Electric Railway Company.

F. O. Dolson, erecting engineer, with the Pelton Water Wheel Company, has returned from La Grange, Cal., where he installed an additional Pelton-Francis turbine direct connected to a 450 k.w. generator for the La Grange Water & Power Co. Current is furnished for Turlock, Modesto and La Grange. The company operates one of the largest gold dredges in the State near La Grange.

BANQUET TO SOUTHERN CALIFORNIA EDISON OFFICIALS.

A banquet was tendered the officials of the Edison Electric Company of Los Angeles by the citizens of Long Beach on May 25th in celebration of the company's decision to erect its new 40,000-h.p. steam generating plant at Long Beach. The dining-room of the Hotel Virginia was elaborately decorated, 25,000 small colored electric lights being used and four electrical fountains. At the entrance to the banquet hall, the guests were confronted with a revolving electric wheel which at ten-minute intervals stopped, all the lights going out but those which spelled in large letters the word "Edison." The Pacific Electric Company furnished a special car free to carry the Los Angeles guests to the Hotel Virginia and return. The Edison men who were present were: W. A. Brackenridge, vice-president and general manager; R. H. Ballard, secretary and assistant general manager; S. M. Kennedy, general agent; B. F. Pearson, general superintendent; J. A. Lighthipe, electrical engineer; W. L. Percey, treasurer; E. W. Sax, auditor; John Otto, purchasing agent; C. H. Coulter, assistant purchasing agent; H. W. Dennis, construction engineer; W. C. Sterling, general storekeeper; H. W. Burkhart, gas engineer; A. W. Childs, assistant general agent; R. E. Cunningham, assistant superintendent;" F. B. Lewis, assistant superintendent; W. L. Boxall, power contract agent; William Dieterle, power development agent; H. C. Stinchfield, chief surgeon; R. J. C. Wood, engineer; C. H. Pierson, advertising agent; A. E. Morphy, assistant secretary; W. J. Wallace, right of way agent; M. D. Mann Jr., engineer; E. H. Warner, engineer; J. N. Pyster, engineer; C. S. Walton, Los Angeles district agent.

TRADE NOTES.

The Pacific States Electric Company will open a branch house at 90-92 Seventh street, Portland, Ore., early in June.

The Ransome Concrete Company announce the removal of their main offices from the Crocker Building to the Mechanics' Institute Building, 57 Post street, San Francisco.

The Western branch of the Cutter Electrical & Manufacturing Company has been moved to 98 Jackson boulevard, Chicago, under the management of H. F. Darby Jr.

The Pacific Gas and Electric Company has acquired the light and water power holding of E. D. M. Lehe of Dixon. It is the purpose of the purchasers to develop the plants formerly owned by Lehe and extend the lighting and water pumping services to the rural districts surrounding the towns in which plants have been secured. Lehe owned the lighting plants and water supply stations at Wheatland, Lincoln, Davis, Roseville, Cordelia, Elmira, Winters, Dixon, Rio Vista and Benicia.

The General Electric Company reports that the Sierra & San Francisco Power Company has ordered, for the North Beach power station of the United Railroads, an additional 9,000-kw. Curtis turbine generator with condenser base. The new 60-cycle machine is rated as follows: A. T. B. 10, 9,000-kw. maximum capacity, 720 r.p.m., 11,000 v. When this has been installed the present 5,000-kw., 25-cycle Curtis turbine set in the station will be remodeled by the substitution of a 9,000-kw. (max.) generator.

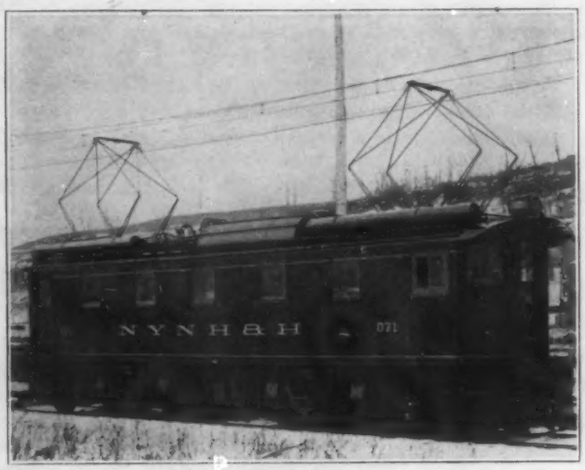
W. J. Krase, constructing engineer of the Pelton Water Wheel Company, has gone to Metaline, Wash., to install several water wheels for the Inland Portland Cement Company. This concern is affiliated with the Lehigh Portland Cement Company and will use a large amount of current for the operation of its own factory. The Sylvester Company of Spokane are the erecting engineers. The wheels are of about 2,500-h.p., operating at 360 r.p.m. under a head of 450 ft., and each is direct connected to a Westinghouse generator. There will be two Pelton and Westinghouse 125-kw. exciter sets operating at 600 r.p.m. The water of Sullivan Creek will be used in the wheels and discharged into the Pen'd Oreille River.

INDUSTRIAL

ELECTRIC LOCOMOTIVE PERFORMS WELL IN TESTS.

The Westinghouse Electric & Manufacturing Co. completed recently the 150-ton locomotive for use on the electrified section of the New York, New Haven & Hartford Railroad between Stamford and New York City. The entire electrical equipment, including the spring drive of the motors, is the design of the Westinghouse company, while the mechanical parts were designed by the engineers of the Baldwin Locomotive Works and the New Haven Railroad Company.

The specifications required that the locomotive be able to haul a 1,500-ton freight train at a speed of 35 miles an hour on level track, where the train resistance is not over six pounds per ton. They also required that the locomotive be capable of hauling an 800-ton passenger train at a speed of 45 miles an hour. This capacity would enable it to haul an 800-ton limited train from the Grand Central Station, New York City, to New Haven, a distance of 73 miles, with no intermediate stops, in one hour and fifty-five minutes; or to haul an 800-ton express train the same distance in two hours and twelve minutes, with an allowance of five minutes for stops; or to haul a 350-ton local train in two hours and forty-five minutes with an average stop of forty-five seconds.



150-ton Westinghouse Electric Locomotive.

That the locomotive is an unqualified success has been demonstrated by frequent tests made under severe operating conditions. Besides proving itself in other ways, it has hauled 37 loaded cars, a heavy freight engine and a caboose from New Rochelle to Stamford, a distance of 18 miles, in 27 minutes. Although this run was made in a drizzling rain that froze as fast as it fell and made the tracks very slippery, the engine attained a speed of 49 miles an hour. During some tests made at the works of the Westinghouse company at East Pittsburg, Pa., the locomotive started and accelerated a 2,100-ton freight train both on level track and on an upgrade of 0.3 per cent on a 3-degree curve. A train corresponding to the 800-ton passenger train was accelerated at a rate of about 0.4 miles per hour per second and quickly reached the required speed. For hauling trains the new locomotive has about twice the capacity of any one of the locomotives already in use on the New Haven Railroad. Each motor has a one-hour rating of about 373 h.p. and a continuous rating of approximately 310 h.p. The tests made have shown that the locomotive has a good margin over the specifications. By its performances it has shown conclusively that it can amply fulfill the service conditions.

The design of the trucks and running gear of the locomotive is unique. The truck frames are connected by an intermediate drawbar. One truck has only a rotative motion about its center pin, while the other has a fore and aft, as well as a rotative motion, in order to compensate for the angular positions of the trucks and drawbar when the locomotive is traversing a curve. The tractive force is transmitted through the truck frames and drawbar instead of through the main frame. Each truck has two pairs of driving wheels and a single pair of leading wheels. The wheel loads are equalized as in steam locomotive practice. To assist in reducing shocks and keeping the two trucks in alignment, chafing castings and spring buffers are interposed between the truck frames under the center of the locomotive. The weight of the cab, instead of being carried on the center pin, is carried on friction plates at the ends of the truck. The weight is applied through springs which have a considerable latitude of motion to allow for variation in the track without changing materially the distribution of weight on the ends of the truck. The plan of running-gear and cab support adopted for this locomotive prevents any periodic vibration or "nosing," minimizes shocks on the truck and road bed and insures easy riding. As the rigid wheel base is only 7 ft. for each truck, the locomotive is extremely flexible and easy on the track at curves and special work.

The electrical equipment, which was built and mounted by the Westinghouse Electric & Manufacturing Co., comprises four single-phase geared motors, together with the auxiliary apparatus necessary for their operation from the 11,000-volt, alternating current, or 600-volt, direct current circuits of the electrified sections of the New Haven and the New York Central railroads, respectively. The motors are of the same general electrical design as those in use on the present New Haven locomotives, the main differences being in the mechanical details and general arrangement.

Each motor is rigidly mounted on the truck frame and directly above a quill surrounding the driving axle, to which it is geared. The motors project into the cab and the floor above them is raised. This method of mounting the motors on the truck frame gives a high center of gravity and prevents the transmission of strains and shocks from the track and road bed to the motors.

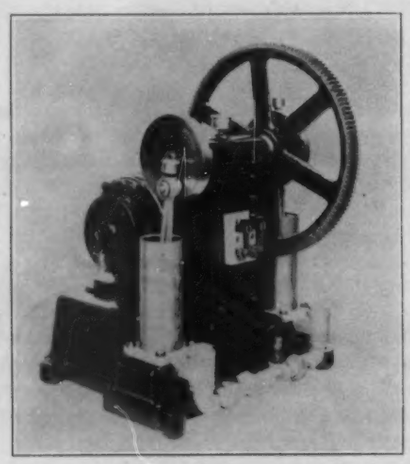
An air blast transformer is provided for lowering the trolley line voltage to that required by the motors. The control apparatus is of the Westinghouse electro-pneumatic type. When operating on alternating current all four motors are connected in multiple and the control is obtained by changing the connections to various voltage taps on the main transformer. On direct current the motors are first grouped all in series, and then two in series and two in parallel in combination with various resistance steps. Provision is made for cutting out any one of the four motors singly on either alternating current or direct current. A master controller and brake valve are located in each end of the cab so that the locomotives can be operated from either end, and the system of control is such that two or more locomotives can be coupled together and operated from one master controller. The speed control is extremely flexible.

Two pneumatically-operated pantograph trolleys are provided for collecting current from the 11,000-volt alternating-current line. Pneumatically-operated third-rail shoes are used to collect current on the direct-current third-rail section.

AUTOMATIC VACUUM PUMP.

The Keuffel & Esser Co. of San Francisco and New York have recently placed upon the market an improved automatic vacuum pump and air compressor. The pump is intended for maintaining vacuum for blue printing frames, compressed air for bicycles, automobiles and experimental purposes.

The pump may be converted into a vacuum or pressure pump by simply reversing the valve discs. The controlling mechanism is securely enclosed in the bearing pedestal and is such that it can be readily cut out and the pump operated at will, and, if desired for continuous use as a pressure pump, the vacuum controlling mechanism may be readily changed to automatically operate the pump as a compressor, which may be readily adjusted to maintain any desired pressure.



Automatic Vacuum Pump.

The pump shown here is adjusted to maintain a vacuum of from 10 to 20 in. The operation of the pump is as follows: The pump is connected to a vacuum tank and on closing the switch the pump starts up and runs until 20 in. vacuum is obtained, when the pump automatically stops and remains at rest until the vacuum drops to 10 in., which again starts the pump, continuing until 20 in. again is reached and then stops.

Any pressure or vacuum within the capacity of the pump may be automatically obtained. The pump and automatic controlling apparatus was designed by L. St. D. Roylance, electrical and mechanical engineer of San Francisco, for the Keuffel & Esser Co.

NEW CATALOGUES.

A pamphlet on exhaust fans has recently been published by the Crocker-Wheeler Company of Ampere, N. J., as Bulletin No. 124.

Bulletin No. 124 from the Electric Storage Battery Company deals with the "Exide" battery in emergency service in central stations.

"The Story of the Storage Battery" and the intimate connection of the Electric Storage Battery Company therewith is well told in an interesting booklet from this company.

"How to Light Your Home by Electricity" with gas engine, generator and storage battery is illustrated and described in a book recently issued by the Electric Storage Battery Company.

Bulletin 119 on large engine type d.c. generators, recently issued by the Crocker-Wheeler Company of Ampere, N. J., contains much information useful to any central station man.

Bulletin 121 from the Crocker-Wheeler Company of Ampere, N. J., describes small direct current engine-type generators. It is handsomely illustrated throughout with half-tone engravings.

HOUSE ORGANS DISCUSSED BY THE TECHNICAL PUBLICITY ASSOCIATION.

The thirty-seventh regular monthly dinner and meeting of the Technical Publicity Association was held on Thursday evening, May 12th, in the galleries of the National Arts Club, 14 Gramercy Park, New York. The subject of "House Organs" was the topic for the evening and proved extremely interesting to all present. In conformity with a recent decision, the chair was turned over to the chairman of the special program committee for the evening, Mr. S. M. Wilson, who assumed the toastmaster's role for the balance of the evening.

In introducing the first speaker of the evening, Mr. C. R. Lippman, advertising manager of the Genuine Bangor Slate Company, Mr. Wilson referred to the March, 1907, "House Organ" night of the association when six speakers entertained a large audience through a long evening. He said that with 500 house organs in the field and the subject of growing importance and interest the members could expect some real beneficial remarks from the speakers.

Mr. Lippman prefaced his remarks on the "Policies of House Organs" by the statement that there are but 500 house organs in this country although there are almost a million firms doing business, indicating that the house organ is only in its infancy. He classified house organs into six divisions, as follows:

First—House organs issued to salesmen and agents.

Second—House organs for dealers.

Third—House organs going to technical consumers, that is, consumers who do not resell the goods but use them in their own business or else specify them.

Fourth—House organs going to the ultimate consumer.

Fifth—House organs published by retail stores.

Sixth—House organs carrying advertisements.

Mr. Lippmann reviewed more than a hundred specimens of house organs as to their varying nature, make-up and probable effect, and exhibited more than 300 different publications for the education of those present.

The following speaker, Mr. H. S. Snyder, of the Jos. Dixon Crucible Company, delivered an interesting address on "Functions and Advantages of House Organs," which he treated most carefully. Mr. Snyder brought out the essential features which the house organ should possess and how in some ways, it excels other forms of advertising.

Mr. H. M. Wilson, vice-president of the McGraw Publishing Company, New York, read a very able paper entitled "The Attitude of Trade Journals Toward House Organs," in which he expressed the opinion that house organs publishers are infringing on the rights of the trade paper publishers in denying them first hand access to articles for their publications and mentioned other inconsistencies of concerns issuing house organs.

"More Than Half Way" was the title of a paper read by Mr. Clark Schurman of the Dean Hicks Printing Company of Grand Rapids, Mich., in which he urged, in addition to other things, that the advertiser endeavor to study his own proposition more from the buyers' viewpoint than from his own, as is usually the case.

Mr. W. R. Hulbert, in charge of advertising, Goldschmidt Therit Company, New York, speaking to the subject of "Tangible Results from House Organs," read abstracts from numerous letters received from concerns publishing house organs, who testified to the actual results they were able to trace from their publication. A company in Hamilton, O., stated that "one issue of their publication was responsible for $60,000 worth of business in thirty days." The meeting was one of the largest held by the association and, from the intense interest manifested, was a great success.

NEWS NOTES

INCORPORATIONS.

CLE ELUM, WASH.—The Cle Elum Falls Power Company has been incorporated for $1,000,000 by H. J. Manning et al. of Tacoma.

SAN FRANCISCO, CAL.—The Union Water Company of California has been incorporated by W. T. Barnett, C. C. Sullivan, E. T. Zook, A. S. Grain and V. W. Vincent, with a capital stock of $1,000,000.

SAN FRANCISCO, CAL.—The Sierra-San Joaquin Electric Company has been incorporated by Los Angeles capitalists with an authorized capital of $5,000,000 for the development of power on the Tule river in Tulare county, to supply the demand for power in the southern portion of the San Joaquin Valley. A power plant will be located 25 miles from Portervi le, capable of developing 8000-h.p. to supply the Kern and Midway oil fields, including the towns of Taft and Maricopa.

SAN FRANCISCO, CAL.—The Marysville-Colusa Railway Company has filed articles of incorporation. The directors are Charles H. Hammon, Leon de Sabla, Samuel Lilienthal, George E. Springer and Herbert W. Furlong. The authorized capital stock is $1,500,000, of which $30,000 has been subscribed. George E. Springer is secretary of the company. The purpose of the corporation is to build a railroad from Marysville through Yuba City to Colusa, a distance of 30 miles. The new road will be a branch of the Northern Electric Railway.

FINANCIAL.

YACOLT, ORE.—By a vote of 42 to 14 Yacolt voted to bond for the new water system. It will be a gravity system. The source of supply is Big creek falls.

PROVO, UTAH.—Both the proposition for a bond issue of $110,000 for a municipal lighting plant and an issue of $30,000 to increase the waterworks plant carried at the election here last week.

VALE, ORE.—An election will be held for the purpose of voting on the issuance of bonds in the amount of $70,000 to provide funds for the installation of a complete waterworks and sewerage system to cover the entire townsite.

VALE, ORE.—The Council has passed ordinances for an election at which time the voters shall be submitted the question of voting to bond the city in the sum of $75,000 for the construction of a water system at a cost of $45,000 and also a sewer system to cost $30,000, both to cover the entire area within the city limits.

EL PASO, TEX.—An election will be held on June 21st to determine whether or not the city sha'l issue bonds for the purpose of providing waterworks to be owned by the city. The water bond to be in the sum of $375,000, to bear 5 per cent interest per annum, payable semi-annually, and to become due and payable in 40 years, subject to redemption at the option of the city after the expiration of 20 years from date.

SAN FRANCISCO, CAL.—The resolution reopening negotiations with the Spring Valley Water Company looking to a purchase of a part of the company's plant by the city has been referred by the public utilities committee to the Board of Public Works. Supervisor Walsh pointed out that the resolution was vague, in that it did not state what part of the Spring Valley's holdings it was purposed to purchase, and the resolution was referred, with the request that what was needed by the city for a water supply be deliminated.

TRANSMISSION.

MALDEN, WASH.—The Malden Supply & Power Company has purchased a power site at the head of Rock lake, where it is expected 2,000 horsepower can be developed.

VICTORIA, B. C.—A. E. Waterhouse of Seattle has applied for a record on the Spreat river of 500 inches, with the intention of erecting a power plant to supply electricity to Port Alberni.

VICTORIA, B. C.—Sealed tenders have been received by the Hon. Minister of Public Works for the construction of a transmission line for the purpose of furnishing electricity for the Hospital for the Insane at Coquitlam.

BAKERSFIELD, CAL.—The Power- Transit & Light Com, pany is preparing to go ahead with the construction work on its Kern river power plant. It is planned to make the p'ant large enough to answer the demands of a city of 30,000 people.

MOUNTAINHOME, IDAHO.—The Crane Fal's Power & Irrigation Company will begin work immediately on the feed canal and head works of its power plant at Crane falls on the Snake river, 15 miles south of here. The plant wi'l have a capacity of 14,000 horsepower.

GRANTS PASS, ORE.—J. H. Beeman of Gold Hill has announced that the Rogue River Water & Power Company will spend $100,000 developing power this year. Mr. Reed, manager of the company, has announced that the power plant will be built on the Gold Hill Canal Company's property.

PORTLAND, ORE.—The Puget Sound Bridge & Dredging Company, Central building, Seattle, has been awarded the contract for the construction of a masonry dam, 885 feet long and 100 feet high, to cost $1,000,000, across the Clackamas river thirty miles south of Portland for the Portland Railway, Light & Power Company.

ILLUMINATION.

BANCROFT, IDAHO.—Hyrum Call is taking steps to install an electric light plant here.

ETNA, CAL.—W. N. Mullin has presented his plan for a lighting system to the Board of Trustees. A decision will be reached by the Board on or before June 14th.

SHERIDAN, MONT.—O. B. Preston, president of the municipal lighting plant in St. Johns, Mich., will, within four months, install an electric lighting system here. The power site is on Indian creek.

ARCADIA, CAL.—The City Council passed an ordinance granting Chas. S. S. Forney the right to construct, institute, install, lay and maintain under ground conduits, mains and gas pipes in the city of Arcadia.

LOS ANGELES, CAL.—The City Council has adopted the suggestion of the Board of Public Utilities that the maximum rate for electric current be reduced from 9 to 7 cents per kilowatt hour. The new rate goes into effect on July 1.

SAN FRANCISCO, CAL.—Sealed bids for installing a complete electric light system, including fixtures and sub-station at the Presidio of San Francisco, will be received at the office of the constructing quartermaster at Fort Mason, until 11 a. m., June 15th.

PASO ROBLES, CAL.—An ordinance has been passed granting C. F. Hoffman a franchise to lay gas pipes for the purpose of carrying gas for heat, light and power and to erect poles and wires for transmitting electricity, heat and power along, under, over and upon the public highways in San Miguel.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Company has submitted bids for lighting the city's streets and public buildings which on the basis of last year's business would save the city $17,000 for the arc light service and $10,000 on the gas lamps. The schedule proposed by the company has been referred to the committee for recommendation.

MARYSVILLE, CAL.—Manager J. E. Poingdestre of the Marysville district of the Pacific Gas & Electric Company, has received notice from headquarters that his territory will hereafter include Wheatland and Lincoln. Heretofore he has had supervision of the company's business in Marysville, Sutter county, and the northern portion of Yuba county. Material is arriving for the new gas-holder of 100,000 feet capacity, to be installed in connection with the improvements intended in the service for Marysville and Yuba City.

LOS ANGELES, CAL.—The Board of Supervisors will receive sealed bids up to 2 p. m. June 20th for a franchise to lay down and for a period of 50 years to maintain a system of gas pipes in all public roads and highways in the following section: 15, 16, 18, 19, 20, 21, 22, 25, 27, 28, 29, 32, 33, 34, 35 and 36, township 1 north, range 13 west; sections 30 and 31 in township 1 north, range 12 west and sections 2, 3, 4, 9 and 10 of township 1 south, range 13 west, S. B. B. M., omitting from above territory all highways within the limits of the city of Glendale.

SAN FRANCISCO, CAL.—The gas and electric systems at Suisun and Fairfield, owned by Leonard Prior, have been purchased by the Pacific Gas & Electric Company. The transfer of the properties will be made June 1. Though these two systems have been owned by Prior, he for some time past has been purchasing his current and gas from the Pacific company and in turn selling the utilities to the citizens of Suisun and Fairfield. The transaction eliminates him from his position as middleman, and the Pacific company will sell direct and operate its own plants.

TRANSPORTATION.

LOS ANGELES, CAL.—The City Council passed an ordinance granting to Robert Marsh and John Howze the right to construct and for a period of 21 years to operate and maintain a double track electric railway on Vermont avenue.

ONTARIO, ORE.—Attorney A. N. Soliss, representative of Henry Lewitt, a Spokane capitalist, has made application to the City Council for a street railway franchise in Ontario. It is stated that the new line would connect at Snake River near Nyssa, with the Pierce line to Caldwell.

VALLEJO, CAL.—At a meeting of the directors of the Vallejo & Northern Electric Railway Company it was decided to call a special meeting of the stockholders of the company to be held in this city on July 28, at which time the proposition of increasing the capital stock from $2,500,000 to $10,000,000 will be voted upon.

SAN FRANCISCO, CAL.—The United Railroads Company has paid to Treasurer McDougald $34,274.25, the amount due the city as percentages on the gross receipts of the company for the year 1908. There is still unpaid the amount due for 1909, on which no report has been made by the corporation, but which, it is estimated, will approximate $40,000.

SEATTLE.—John E. Ballaine has secured the right from Louis Brennan, of the British War Office, to use the Brennan monorail in Alaska and will establish a line fifteen miles in length, from mile 29 on the Alaska Northern Railway to the Moose Pass district. The Moran Company, of this city, will construct the cars, and Mr. Brennan will make the gyroscopes.

SACRAMENTO, CAL.—J street from Sixteenth to Thirty-first, will be torn up for about 90 days while an asphaltum pavement is being put down and new rails are being laid by the Sacramento Electric, Gas and Railway Company. The old track is to be entirely torn up and new construction is to be put down. The construction is to be standard. The ties are to be laid on a rock ballast, and the rails are to be of the latest grooved type. They weigh 87 pounds to the yard.

SAN FRANCISCO, CAL.—Construction work on the electric line of the Central California Traction Company between Sacramento and Stockton is going forward rapidly, according to the statement of George W. Peltier, president of the company. Three miles of piling and bridge work across the Cosumnes river and lowlands has been completed. A steam locomotive is being used by construction crews between Brighton and Sheldon. Mr. Peltier said that as soon as the track is completed all the way between Stockton and Sacramento the company will put on trains gradually until a 15-minute service is perfected.

WATERWORKS.

MEDFORD, ORE.—Jacobsen-Bade Company has been awarded the contract for the laying of six-inch water mains and four miles of sewer.

LODI, CAL.—H. H. Henderson, a civil engineer, has been awarded the contract to install the Lodi municipal plant for light, water and sewerage.

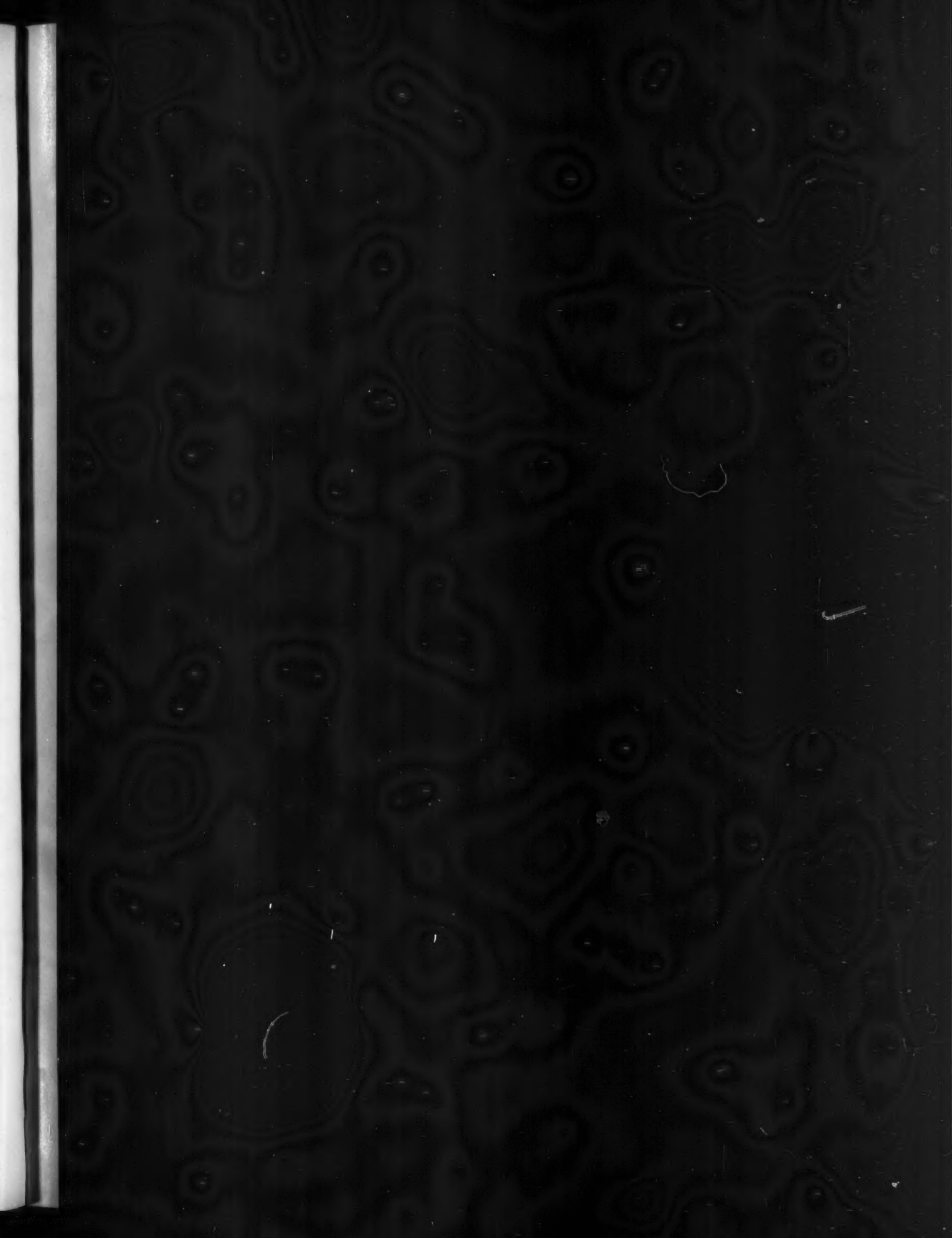
CALDWELL, IDA.—The Hartenbower Bros. of this city have been awarded the contract for the city waterworks system for the bid of $59,733.70.

OAKLAND, CAL.—The contract for the extension of the pipe system of the salt water fire-fighting plant has been awarded to Michael Murphy on his bid of $23,353.40.

EL CENTRO, CAL.—Instead of constructing only a temporary water system for summer use, as was proposed, the City Trustees have decided to install a complete municipal water system.

COTTAGE GROVE, ORE.—The City Council has entered into a contract with the American Water & Light Company of Kansas City, Missouri, for the construction of a water system from Layng creek to connect with the present water system, a distance of 18 miles, the price being the amount voted for the purpose, $100,000.

BELLINGHAM, WASH.—The sum of $4,800 or $12 a foot for the 400 feet of main to be laid is given by Acting Engineer William North as the preliminary estimate of the cost of extending the city's intake into deep water in Lake Whatcom. This estimate includes the cost of wood stave pipe, of the intake proper, with its screens and vales, of the piling and cribbing and of all labor, including that of the diver to be hired.

PASADENA, CAL.—Several of the water companies here are considering developing more water, in view of a dry summer. The North Pasadena Company hopes to build another large reservoir nearer the head of its system, to accommodate users higher up and to keep consumers supplied. The Lake Vineyard Company expects to resort to pumps. The Alhambra Company is deepening its wells and expects to go to the foothills to develop a greater supply.

MILLVILLE, CAL.—The Appellate Court has reversed Judge Head of the Shasta County Superior Court, saying in effect, the Northern Light and Power Company cannot condemn farmers riparian rights. The Appellate Court says, in effect, that that public service corporation can do it by law. Old Cow Creek at its low stage in summer carries, roughly estimated, 3000 inches of water. The farmers living along the stream have irrigation ditches that divert 1000 inches of water, roughly estimated, to their land. This leaves 2000 inches in the creek. These 2000 inches are a riparian water right. The Appellate Court has said that the Northern Light & Power Company may take this 2000 inches and devote it to a public use.